Optical rotation detecting for atomic spin precession based on Mach-Zehnder Interference

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In an atomic spin-exchange relaxation-free (SERF) inertial measurement system, the fluctuation of probe light power greatly limits the improvement of inertial measurement sensitivity. Different from the traditional polarization detection method which measures the change of probe light power to obtain the information of optical rotation induced by atomic spin polarization, a novel polarization detection method based on Mach-Zehnder interferometry technique is proposed and theoretically analyzed in this paper. In this method, an electro-optic phase modulated laser is used as the interferometric measurement source, and the atomic spin polarization is obtained by measuring the phase difference between the two arms of the interferometer. The output of the interferometry is independent of probe light power, which avoids systematic error caused by probe light power fluctuation. At the same time, high frequency electro-optic modulation is used in this method, and the low frequency noise, such as 1/f noise, can be effectively suppressed. The method proposed in this paper can improve the sensitivity and long term stability of the atomic spin inertial measurement system.

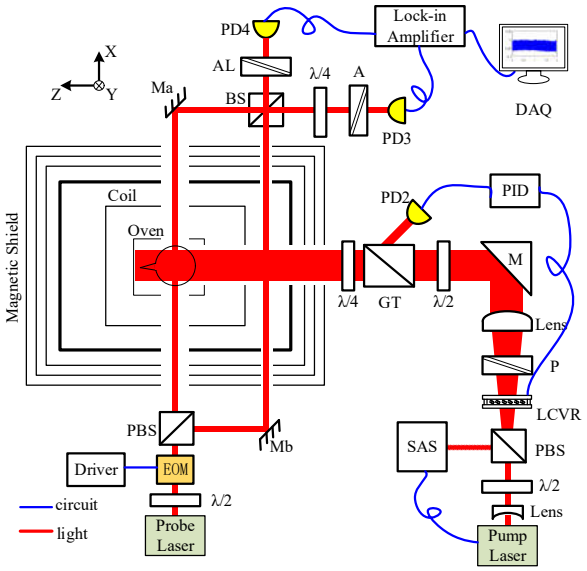

Figure 1: Schematic of experimental setup. EOM: electro-optic phase modulator, PBS: polarizing beam splitter, BS: beam splitter, M: mirror, A: nalyzer, PD: photodiode, DAQ: data acquisition system. LCVR: liquid crystal phase retarder, GT: Glen Taylor prism. P: polarizer, λ/2: half wave plate λ/4: quarter-wave plate SAS: Saturation absorption module

References

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